

Interim Report of

ATSRAC HWG TASK 7

**ELECTRICAL STANDARD WIRE PRACTICES
MANUAL (ESWPM)**

Prepared by Tony Poole & Don Andersen on behalf of the members of HWG 7

Report in Draft Format of TASK 7, ELECTRICAL STANDARD WIRE PRACTICES MANUAL (ESWPM)

1) - Introduction

This report contains the recommendations of the ATSRAC HWG 7. The report has been prepared as a "Draft Report in Draft Format" as requested by ATSRAC. It is the intention of the ATSRAC HWG 7 that this "draft" report will become the "final" report of the group when all the recommendations from other working groups that may arise have been considered and included, and upon the development of a draft Advisory Circular consisting of the attached appendices.

Under the current available specifications (ATA 100, i2200) that exist today, the original airframe manufacturers (OAM) have the choice between two methods of supplying the documentary coverage of required aircraft electrical standard practices. Either:

- Contained in the Wiring Diagram Manual (WDM) where Chapter 20 has been assigned
- Contained in a separate manual dedicated to aircraft electrical standard practices.

These current specifications, however, do not specify the minimum content or a standard arrangement of that material.

Therefore, because there is such a variety of document configurations and titles, this report will use the term "Electrical Standard Wire Practices Manual (ESWPM)" that will also cover and be applicable to the cases where OAMs include the coverage of electrical standard practices as Subject 20 of the wiring diagram manual.

The co-chairs would also like to express their thanks to those members representing the operators, whose expertise and has been instrumental to the working of the group.

2) - BACKGROUND:

At the conclusion of the FAA's *Aging Transport Non-Structural Systems Plan* Phase I, Task 4 Working Group stated that the current presentation and arrangement of standard wire practices make it difficult for an aircraft maintenance technician to locate and extract pertinent and applicable data necessary to effect satisfactory electrical repairs.

The tasking statement assigned to the Task 4 Working Group also required the group to consider the "simplification" of Wiring Diagram Manuals (WDM) Chapter 20. It appeared that a "simplified" Chapter 20 ESWPM manual created by the end-users was not recommended for several reasons:

- It would result in different standards from one end-user to another,

- Due to the lack of source data, it would not be practical for the end-users to do this, and
- The end-user would need the details for inspection, maintenance and repair that are currently in the manufacturer's ESWPM.

The subject of simplification can be addressed by other recommendations, which have been retained in the Task 7 tasking statement and are covered in this report.

It is the aim of TASK 7 Harmonization Working Group (HWG) to carry out and implement the previous ATSRAC recommendations that cover the ESWPM. The result of which will provide the methods to enhance the usage of the ESWPM.

3) – DISCUSSION RESUMEE CONCERNING EACH TASK

ATSRAC accepted several additional tasks in Phase II of the FAA's *Aging Transport Non-Structural Systems Plan*, five of which concerned the continuation of work proposed by Task 4 Working Group concerning the develop of recommended minimum content and standard format for documents providing standard wiring practices. Each subtask assigned the Task 7 HWG are provided below verbatim and is immediately following by the results of our review.

TASK 7.1: Establish a Harmonization Working Group (HWG)
Through this tasking, the FAA intends to implement the ATSRAC Task Group 4 recommendations for a revised ESWPM. The result of this tasking will be a recommendation from ATSRAC for a standardized ESWPM. The FAA will use this recommendation to develop an AC that identifies the standardized structure of major sections for standard practices dealing with wire, cable, and other wiring components. Therefore, ATSRAC is tasked to establish an Electrical Standard Wire Practice Manual (ESWPM) HWG. This HWG should consist of, as a minimum, representatives from:

- *the Air Transport Association (ATA)*
- *operators*
- *aircraft and component manufacturers*
- *regulatory authorities*

The harmonization working group 7 (HWG 7) was established and convened at the first meeting held in Seattle on the 24th July 2001.

The tasking statement required the group to consist of, as a minimum, representatives from:

- the Air Transport Association (ATA),
- operators,
- aircraft and component manufacturers, and
- regulatory authorities.

The selected members of the group comprised of representatives from regulatory authorities, aircraft manufacturers, and operators. The members of the group are:

<u>Task 7 HWG Membership</u>		<u>Co-Chairs:</u> Anthony (Tony) Poole Airbus Tracey Johnson Boeing Replaced by Don Andersen Boeing	
<u>Name</u>	<u>Organization</u>	<u>Name</u>	<u>Organization</u>
Brett Portwood	FAA	Dennis Lee	Air Canada
Dominique Mazzarino	Airbus	Chris Nichols	AirTran Airways
Phillippe Renhas		Robert (Bob) W. Sitz	Delta Air Lines Inc
		Robert (Bob) L. Barnett	Airborne Express
		Scott Christian	United
		Lukas Zuelling	SR Technics Ltd.
Morris Frimer	Boeing		
Dave Padilla		Elias "Eli" Cotti	NBAA
Ramiro T. Esparza II	Boeing (Long Beach)	Percy Constanti	Embraer
Ross Lloyd	Boeing Australia Ltd		

ATSRAC anticipated that the group's activities would require the assistance of an ATA representative and this was reflected in the tasking statement. An ATA representative would have been able to provide valuable inputs to the work of the group and, secondly, be able to directly communicate the results of the working group to the relevant ATA TICC committee. This may have helped to resolve and shorten the relevant ATA committee decision-making process. Although a direct ATA representative did not participate in the HWG, Bob Sitz of Delta represented both the ATA and the airlines in his participation on the team.

As a direct result of the tragic events of the 11th of September 2001, it was difficult for the operator representatives of the group to participate at some meeting locations. As the intent of the task is geared towards a better handling of the ESWPM by the "end-users" i.e. mainly the operators, this affected the required outputs of the group by limiting the discussions and debate at one crucial meeting to only those of the OAMs. Nevertheless, the OAMs were able to review HWG 7 correspondence, and provided feedback on the HWG work outcome & progress. During the period of this HWG, US co-chair Tracey Johnson (Boeing) resigned and was replaced by Don Andersen (Boeing) this change being documented in the ATSRAC meeting minutes of January 23-24, 2002. The group would like to take this opportunity to thank Ms Johnson for her dedication to the work of HWG 7 during her period as co-chair.

Four meetings were held by HWG 7. They were:

<u>Task 7 HWG Meeting Schedule</u>	<u>Date</u>	<u>Location</u>	
Meetings:	July 24, 2001 (Planning)	Seattle WA	Boeing
	October 3 – 4, 2001	Toulouse, France	Airbus
	December 11-13, 2001	Seattle, WA	Boeing
	March 6-7, 2002	Washington, D.C.	NEMA

TASK 7.2: Coordination with other ATSRAC HWGs

In developing the report for ESWPM format, the ESWPM HWG must coordinate with:

- *the Wire System Certification HWG (addressing TASK 6)*
- *the Enhanced Maintenance Practices for Systems HWG (addressing TASK 9)*

Therefore, ATSRAC is tasked to develop a process for coordination between these working groups.

The HWG 7 initially identified the following persons to coordinate with HWG6, HWG8 and HWG9 on a working level.

- Task 6 Dennis Lee, Christian Garros (Airbus alternate)
- Task 8 Ross Lloyd, Scott Christian
- Task 9 Bob Barnett

Subsequently, to ease the coordination process, ATSRAC created an integration team to address this subtask within each of the major tasking statements. The team is comprised of the following primary and backup individuals:

- HWG 6 - Vid Variakojs/Jack Evans
- HWG 7 - Tracey Johnson/Don Andersen
- HWG 8 - Paul Lapwood/Spencer Bennett
- HWG 9 - Randy Boren/Gil Palafox
- Leader - Mike Nancarrow

This integration team process was accepted by ATSRAC in July 2001.

The purpose of the integration team is to coordinate all activities and issues associated with Tasking Statements 6 through 9 in behalf of ATSRAC. The objectives of this function are to:

- Help achieve successful program completion by August 2002
- Provide ongoing program visibility to ATSRAC members
- Identify issues and solve problems with each working group before ATSRAC meetings
- Ensure all action items are properly addressed before ATSRAC meetings
- Be ready - provide all necessary data to ATSRAC members that will facilitate decision making

The integration team holds weekly teleconferences whereby inter-working group issues are addressed and information is exchanged. A periodic status report is provided to the ATSRAC membership via the integration team leader.

TASK 7.3: Define a Standard Format

ATSRAC is tasked with defining a standard format for the ESWPM that meets the following characteristics:

- *The ESWPM format and organization must provide operators of different aircraft types from different manufacturers the ability to retrieve standard wiring repair and maintenance information from the maintenance manual or wiring diagram manual.*
- *The information and data format must be useable and readily retrievable by field level technicians who are performing the maintenance and repairs.*
- *Human factor considerations must be taken into account when defining the structure of the manual, so that the potential for human error will be minimized in interpreting wiring practices information.*
- *The structure of the manual also must allow inclusion of wiring repair and maintenance information supplied by component manufacturers [e.g., line replaceable units (LRU) and other types of system equipment], such that wiring repair and maintenance information for entire wiring systems (including both aircraft wiring and system/subsystem wiring) can be readily retrievable.*
- *The structure and organization method must be developed to facilitate classification of wiring systems-related corrective action for reliability reporting.*

The discussions concerning the creation of a standard structure or format for the ESWPM resulted in the establishment of the following requirements:

- Ensure that the usability and readability of the ESWPM by field level technicians working on different aircraft types from different manufacturers was improved.
- The information and data format must be useable and readily retrievable by field level technicians who are performing the maintenance and repairs.
- Ensure that the format allowed potential for ESWPM growth
- Ensure that consideration of any human factor concerns that may arise when using ESWPM were considered, e.g. to ensure that those users with English as a second language were considered when assigning titles to sections or groups of the ESWPM.

The tasking statement also stipulated that the structure of the manual should include wiring repair and standard practices information supplied by component manufacturers (e.g. line replaceable units LRU and other types of system equipment etc).

The above wording of this task was considered at length and then altered by the group. The rationale for this change is that the Task 4 final report stated that "*The structure should also make provisions for use by component manufacturers*" which is interpreted differently than the Task 7.3 requirement.

The HWG 7 interpretation of the Task 4 phrasing is that it does not imply inclusion of vendor data in the ESWPM but, rather, that the ESWPM structure should be such that a supplier could use the standard format developed by HWG 7 to structure their own electrical standard practices documentation.

That is, the vendor manuals supplied for workshop use when maintaining line replaceable units (LRUs) and other types of system equipment etc. should use the same basic structure/format as the ESWPM when describing electrical standard practices.

Therefore the group recommends (full consensus) that:

- A revision to the ATA specification (ATA 100, 103, i2200) should be considered by the relevant ATA committees to revise the specification related to vendor component data structure/format.
- The format/structure of the wiring repair and standard practices information contained in component manufacturers documentation should use a specific chapter within each document using a structure/format that will conform to any ATA specification revisions that may result from the recommendations of HWG 7.

To determine the best approach to use in defining a common format a complete analysis of various manufacturers' ESWPMs was carried out. The manuals covered were:

- Boeing – Puget Sound- Standard Wire Practices Manual (SWPM)
- Boeing Long Beach- Standard Wire Practices Manual (SWPM)
- Airbus - Electrical Standard Practices Manual (ESPM)
- Embraer WDM ATA 20
- Bombardier WDM ATA 20
- Dassault WDM ATA 20.

During the investigation of this task, the HWG has had to take into account three important aspects pertaining to technical publications in general and the ESWPM in particular i.e.

- The breakdown (i.e. assignment of material)
- The numbering of the assigned material.
- The fact that, even though today the use of electronic documentation is widely used and continuing to rise, there are still a number of operators that continue to use paper documentation.

The investigation and subsequent analysis resulted in the creation of a HWG 7 Working Document (Attached) covering the current assignment of all topics provided within the different manufacturer's ESWPMs that were studied.

This working document analysis revealed that, as a direct result of the lack of a precise specification provided by ATA covering the assignment of material to be included in an OAMs document, the breakdown or format of the different documents differed considerably.

In fact, each OAM has established a format:

- In compliance with their own publication philosophy, while globally still complying to the spirit of the ATA specifications
- By applying their company policies covering the supply and the format of the documentation. Note: this policy also includes all maintenance documentation produced and delivered by each OAM.
- By taking into account recommendations from their operators in order to improve the usability of their publications
- Using current publication software tools in use at the publication department of each OAM, including the development and introduction of new technology.

The definition of a new layout and chapter organization would therefore, require each OAM to reorganize and to republish their ESWPM. Whether the OAM produces a standalone manual (ESPM or SWPM) or provides the electrical standard practices as ATA 20 of the wiring diagram

manual, the resultant reorganization would result in a significant economical impact for the OAMs and the end users.

Therefore it was important for HWG 7 to define a solution which would take into account the consequences in term of:

- The technical publication philosophy of all considered OAMs,
- The cost economics due to an immediate major manual overhaul,
- The disturbance caused to the end-users that have become accustomed to the current format they use.
- The possible competition advantage which could be given to one OAM by forcing other OAMs to adopt a similar breakdown and structure as theirs. This would be detrimental to the end-user of that competitor's ESWPM forcing them to use an unfamiliar format.

The work direction of this group was therefore to define an acceptable compromise, acceptable to all OAMs, while satisfying the intent of the tasking by providing improved usability of the ESWPM for the end-user. The information and data format must be useable and readily retrievable by field level technicians who are performing the maintenance and repairs taking into account the traditional paper format ESWPM and also different OAM's "electronic" versions of the ESWPM.

When using a traditional paper format ESWPM, the most efficient method of retrieving standard procedures and maintenance information from the ESWPMs is traditionally made by use of:

- the Table Of Contents (TOC) and/or
- the Indexes i.e. alpha-numerical index and/or numerical index as available (depends on OAM).

However, for aircraft maintenance technicians to locate and extract the pertinent and applicable data necessary to effect a satisfactory design modification or to perform a maintenance action, locating the relevant data may be time consuming. This entry method relies heavily on the quality of the TOC and/or the Indexes.

The study of the OAM ESWPM manuals showed, for example, that the TOCs do not always provide detail and content for the subsections directly within the TOC, but at the head of each subsection. This illustrates a difference of publication philosophy between OAMs. As far as TOCs are concerned, one OAM will consider that a front TOC should not exceed more than 20 pages thus being possibly restrictive in the Titles and limiting the search. Whereas another OAM will consider a full TOC of 50 pages is affordable, but possibly onerous to the reader-searcher.

The alpha-numerical indexes provided by some OAMs as an additional entry point have the benefit of narrowing the search criteria to the standard and/part number of the wiring component on which the reader requires information. This method is particularly efficient using a keyword search if the user has the correct information (PN or STD) as it is this PN or STD that the reader uses to enter directly to the related information. It is therefore apparent that the entry points, TOC and alpha-numerical Indexes may fulfil their intended role if they correctly reflect the content of the ESWPM.

Because the current and future philosophy of some OAMs is to issue documentation (including the ESWPM) in an electronic format, the use of an "electronic ESWPM" that includes a search engine was considered. The use of an "electronic ESWPM" would negate the requirement for a user to rely on knowledge of the rules that cover assignment of the subject matter (ATA reference) as listed by the TOC. Instead he would initiate an "electronic" search for required information. The success of the search is not dependent on a knowledge of the assignment of material, but more on the phrases used to initiate the search.

The opinion of the group was that, as there are users that continue to use "paper format" ESWPM and will continue to do so for a considerable period of time, these users must be considered in the recommendations of the group. Also the recommended format should be acceptable and suitable for an ESWPM in a paper format while at the same time ensuring that the benefits of future "electronic" manuals are not impaired.

HWG7 is proposing the use of a common format index identified as the Master Breakdown Index (MBI) for all existing ESWPM. The content and arrangement of this index is contained within Appendix 2 (Table 1) to this report. The intent of the MBI is to supplement the TOC and existing indexes by providing to users a method of searching existing documents using topical information as well as by part number, alphabetic subject, or Chapter-Section-Subject reference. The arrangement of the MBI duplicates the basic common format developed by HWG7 but does not require complete rearrangement of legacy documents to achieve a common format. The MBI acts as a conversion key used to effectively convert an existing document arrangement into the proposed arrangement. In essence the MBI duplicates in paper form for legacy documents the electronic search engine for HTML-based documents.

Therefore the HWG 7 recommends (full consensus) that a revision to the applicable ATA specifications (ATA 100, i2000) should be considered by the relevant ATA committees. This revision should provide the producers of electrical standard practices data with a specification that describes a format (breakdown) covering the assignment of that data. This data may be contained in:

- The Wiring Diagram Manual (WDM), where Chapter 20 has been assigned for the purpose
- In a separate manual dedicated to aircraft electrical standard practices.

This revision to the ATA specification should provide details of a common format/structure of the wiring repair and maintenance standard practices information in accordance to the attached table 1 breakdown document (general consensus). The implementation details are covered by the recommendations covering Task 7.5 below.

Note: This proposal did not receive full consensus as the dissenter (Airbus) feels that:

1. The subject "Safety Practices" should be assigned a complete section (Group) and not be considered as part of general data because of its importance.
2. No mention of the required "Front Matter Pages" that were part of the original agreed MBI.
3. No mention or assignment of the required "Introduction". It is the "Introduction" of all manuals that contains the "How to Use the Manual" information plus other important information such as the effectivity of the manual;
4. The proposed Table 1 does not take into consideration the technical publication philosophy of all OAMs.

TASK 7.4: Define a Standard Minimum Content

ATSRAC is tasked with defining the minimum content for the ESWPM. The minimum content will define standard categories to be included in the ESWPM. It will not define the actual procedures associated with the standard content that is pertinent to each manufacturer. The standard content will include the characteristics described below. The technical content is to use source data from ATA Spec 117 and applicable FAA Advisory Circulars, and must address the following subjects, as a minimum:

Cleaning Requirements and Methods:

"Protect, clean as you go" philosophy.

- Non-destructive methods for cleaning dust, dirt, foreign object debris (FOD), lavatory fluid, and other contaminants produced by an aircraft environment from wiring systems*
- Wire replacement guidelines when an accumulation of contaminants, either on the surface and/or imbedded in the wire bundle, cannot be safely removed*

Wire and Cable Identification.

- Specify requirements for wire and cable identification and marking to provide safety of operation, safety to maintenance personnel, and ease of maintenance*

Specify methods of direct wire marking. Also, identify specific requirements and cautions associated with certain types of wire marking.

Wire and Cable Damage Limits.

Specify limits to positively identify the thresholds where damaged wire/cable replacement may be necessary and where repairs can be safely accomplished. Establish limits for each applicable wire/cable type, if necessary.

- Include damage limits for terminals, studs, connectors, and other wiring system components, as necessary.*

Installation Clamping and Routing Requirements.

- Specify the requirements for the installation of wiring systems with respect to physical attachment to the aircraft structure. These requirements must be compatible with the different environments applicable to aircraft and aircraft systems.*
- Specify applicable methods of clamping, support, termination, and routing to facilitate installation, repair, and maintenance of wires, wire bundles, and cabling.*
- Establish minimum bend radii for different types of wire and cable*

- *Specify minimum clearance between wiring and other aircraft systems and aircraft structure.*
- *Include the requirements for the installation of wiring conduit with respect to physical attachment, routing, bend radii, drain holes, and conduit end coverings.*
- *Emphasize special wiring protective features, such as spatial separation, segregation, or shielding, that are required to be maintained throughout the life of the aircraft.*

Repair and Replacement Procedures.

Describe methods to safely repair and/or replace wiring and wiring system components.

- *Include types and maximum numbers of splice repairs for wiring. When splicing wire, environmental splices are highly recommended over non-environmental splices. Guidance should be provided on how long a temporary splice may be left in the wire.*
- *Specify procedures for the repair, replacement, and maintenance of connectors, terminals, modular terminal blocks, and other wiring components.*

Inspection Methods.

In wiring inspection methods, include a general visual inspection (GVI), or a detailed inspection, as determined by the enhanced zonal analysis procedure. Typical damage includes heat damage, chafing, cracked insulation, arcing, insulation delaminating, corrosion, broken wire or terminal, loose terminals, incorrect bend radii, contamination, and deteriorated repairs

- *Identify detailed inspections and, where applicable, established and emerging new technologies non-destructive test methods to complement the visual inspection process.*

Whenever possible, ensure that inspection methods can detect wiring problems without compromising the integrity of the installation.

The group agrees (full consensus) that a definition and description of ESWPM minimum content is necessary and should clarify which items must be included in the ESWPM giving operators and repair stations the information necessary to maintain their airplanes. We also agree, understand and respect the manufacturer's electrical installation design philosophy concerning components, installation procedures, segregation rules, etc. but recommends (full consensus) that these should be included as part of the ESWPM standard content. This will enable the end-user to maintain the aircraft in a condition that conforms to the original or current manufacturer's electrical installation design philosophy.

In addition to the minimum content defined within the terms of reference, HWG7 also included as minimum ESWPM content procedures for the protection of wiring from moisture ingress as a result of the recommendations emanating from the Intrusive Inspection Working Group.

HWG7 agreed (full consensus) that the attached Detailed Minimum Content (Table 3) covers the required minimum content as stated in the tasking statement listed above. In addition, we recommend (General consensus) that Table 3 to this document be used as a reference when establishing the minimum content to be covered by the ESWPM standard format (Refer to Task 7.3 above).

Note: This proposal did not receive full consensus as the dissenter (Airbus) feels that:

1. The Table 3 (Minimum content –Additional detail) does not reflect the primary structure of the minimum content as required by the initial tasking statement. E.g. the major topics and sub-topics are not consistent in each group.
- 2) The proposed Table 1 does not take into consideration the technical publication philosophy of all OAMs

TASK 7.5: Recommend Updates of Existing ESWPMs.

ATSRAC is tasked to consider and make recommendations to the FAA on whether to update ESWPMs already in use under existing airline and repair station programs. ATSRAC must provide adequate justification for their recommendations. If ATSRAC determines that existing manuals should be updated, the FAA requests that a proposed method and compliance schedule be included in the recommendation.

HWG7 has recommended the use of a Master Breakdown Index (MBI) for all existing or legacy wiring practices manuals. The intent of the MBI is manifold, one of which is to provide an index whereby a technician could access the data within the legacy manual using the preferred document format. Once an MBI has been applied to all legacy documents, accessing the internal data becomes a matter of referring to the section of the MBI which collects the relevant information and then determining in which specific section of the manual the relevant information appears. Using the MBI on legacy manuals creates a common look that precludes the need to revise the entire contents of the legacy document. Using an MBI effectively recreates in paper form the process used by a electronic search engine when identifying the location of desired information.

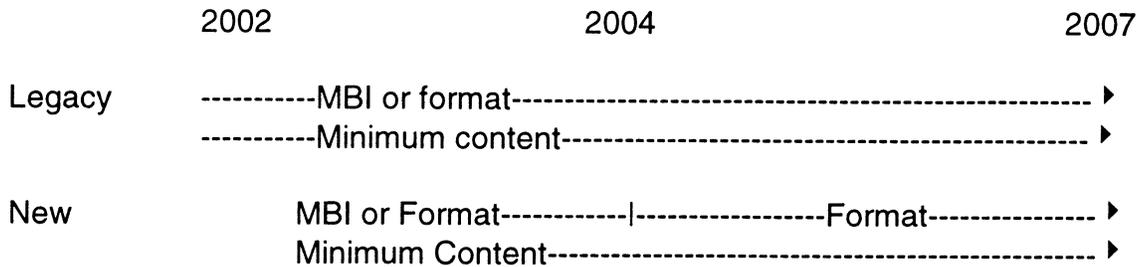
Use of an MBI can be considered either an interim step until such time as a complete rearrangement of a legacy document can be made to conform to the common format. Or it can be considered as a final step as a rearrangement is not needed by the presence of this index. The implementation of an MBI can be readily made to a legacy document whereas a complete rearrangement of the ESWPM, and changes to the inherent references to the ESWPM in other documents, will require much more effort.

Therefore HWG7 is proposing (full consensus) that legacy documents be upgraded to include either an MBI within two years time, or revised to accommodate the common format within five years time. The HWG7 also recommends that legacy documents be updated within two years to include the minimum content as defined in the attachment

New documents to accommodate new airplane models, if not common across all models produced by an OAM, may or may not already be committed to be produced according to i2000 standards in place now. Therefore a grace period commensurate with the development of new manuals is needed to accommodate a change in the specified format of these manuals.

Again, HWG7 is proposing (full consensus) that new documents released after two years include the minimum content as defined in the attachment. The HWG7 further recommends (full consensus) that all new ESWPM documents incorporate the recommended common format within five years time.

Implementing these recommendations will ensure that all ESWPM documents have within two years time the minimum content and either an MBI or the common format as defined in the attachment. New ESWPM documents released after five years will have both the common format and the minimum content.



4) Summary

The tasking assigned to HWG7 is complete. The team, comprised of representatives from airlines, regulatory agencies and OAMs, formed a general consensus with regard to a common format and full consensus for the minimum standard content and an implementation plan for existing and new electrical standard wiring practices documents.

5) Recommendations

In addition to the conclusions and recommendations offered within the appendices to this report, HWG7 would also like to offer the following recommendations which, although not specifically related to the tasking statements, were nonetheless discussed and considered by the team during our deliberations: With the expectation that with the HWG7 recommendation, the ATA develop a specification concerning the standard format, numbering and content for electrical standard wiring practices manuals , Therefore HWG7 has developed a proposed numbering scheme using our industry knowledge and experience (General consensus).

Note : This proposal did not receive full consensus as the dissenter (Airbus) feels that the actual assignment numbering should be specified by the ATA committee responsible for the specifications covering aircraft maintenance documentation. The proposed numbering Table gives a possible competition advantage, forcing other OAMs to adopt a similar breakdown and structure as theirs and does not take into consideration the technical publication philosophy of all OAMs

6) Appendices



MBI-Mazzarino

Appendix 1 HWG 7 Working Document

Appendix 2 Master Breakdown Index / Standard Format / Minimum Content



MBI / Minimum
Content

Appendix 3 Detailed Minimum Content



Minimum Content -
Additional Detail

Appendix 4



ESWPM - Proposed
Numbering Scheme

?	LEP	LEP			minimum content	?	?	?
?	(in 20-00-00)	CROSS-REFERENCE INDEX				?	?	?
Safety Practices								
?	20-1X-XX	20-00-00	Safety Practices	Safety Practices	Safety Practices	?	?	?
Rules & practices associated with Design and/or implementation	20-00-00	Design standards - explanations	Inspection	Inspection	Inspection	?	?	?
Wiring procedures 20-10-00	Title + 20-2X-XX etc	Installation of wires 20-1X-XX			identification coding	?	?	Wires Maintenance Practices
Wiring procedures 20-10-01	Title + 20-3X-XX etc	Installation of wires 20-10-11			routing	?	?	?
Fight guidance sys 20-11-00	Title + 20-4X-XX etc	Wire harness supports 20-10-12				?	?	?
etc	Title + 20-5X-XX etc	Wire separation 20-10-19				?	?	?
		Fiber optic cable 20-12-11				?	?	?
		etc				?	?	?
Wiring components Processes			wording TBD	repairs				
Shield Maint Pract 20-10-02	Title + 20-2X-XX etc	Install of Shrink sleeves 20-10-14			R/I of wiring system components	?	?	Connection Description
Soldering Procedur 20-10-05	Title + 20-3X-XX etc	Termination cable stricks 20-10-15			Assembly/size of WSC	?	?	?
Heat shrink tubing 20-10-06	Title + 20-4X-XX etc	Heat-shrink fittings 20-10-16			locking	?	?	?
etc	Title + 20-5X-XX etc	Install Zippertubing 20-10-17			marking eg of cables	?	?	?
		Install Sleeves on wiring 20-10-18				?	?	?
		Install Press Bulk Seals 20-10-20				?	?	?
		Four leader raceway seal 20-10-21				?	?	?
		Assembly AIDS Firewall 20-14-51				?	?	?
		etc				?	?	?
Rules and practices pertaining to Maintenance		Maintenance criteria standards > / p	wording TBD	?				Line operation procedures
Wire Splice Maint 20-10-03	Title + 20-2X-XX etc	Repair elec wire/harness 20-10-13			inspection limits	?	?	Wires Maintenance Practices
Coil & stow Maint 20-10-04	Title + 20-3X-XX etc	Repair flex elec conduits 20-10-91				?	?	?
etc	Title + 20-4X-XX etc	Repair Prim Fight off wire 20-14-11				?	?	?
	Title + 20-5X-XX etc	etc				?	?	?
		Cleanings				?	?	?
		inspection criteria				?	?	?

FLOWCHARTS / STATE DIAGRAMS / GENERIC SPM CONCEPT TREE
See Tfiguide1.xls

20-00-00 GENERAL	20-00-00 GENERAL	20-00-00 SAFETY-PRACTICES			20-00-00 Sid Pract. Descriptio		
20-1X-XX WIRING PROCEDURES	20-1X-XX SAFETY PRACTICES	20-1X-XX INSTALLATION OF ELECTRICAL WIRES AND WIRES HARNESSSES			20-10-00 Safety Practices - Maint Practices	20-10-00 Standard Practices - Safety Precautions	
20-2X-XX TERMINATIONS	20-2X-XX STANDARD TOOLS	20-2X-XX ELECTRICAL BONDS AND GROUND			20-21-00 Wiring repair	20-20-00 Wires Maintenance Practices	
20-3X-XX ELECTRICAL CONNECTORS	20-3X-XX STANDARD RULES AND RECOMMENDATIONS	20-3X-XX INSTALLATION OF ELECTRICAL WIRE TERMINALS				20-30-00 Connection Description	
20-4X-XX BUSES	20-4X-XX STANDARD ELECTRICAL ITEMS AND CONNECTING PARTS	20-4X-XX ASSEMBLY OF SOLDERED ELECTRICAL CONNECTIONS					
20-5X-XX BONDING AND GROUNDING	20-5X-XX MAINTENANCE PROCESSES	20-5X-XX ASSEMBLY OF COAX CONNECTORS			20-50-00 Elect Connectors		
20-6X-XX CIRCUIT BREAKERS		20-6X-XX ASSEMBLY OF CONNECTORS CONTACTS UNDER SPECIAL CONDITIONS					
20-7X-XX FIRE DETECTION CONNECTORS		20-7X-XX ASSEMBLY OF ITT CANNON DPX, DPD, AND DPA SERIES CONNECTORS					
		20-8X-XX ASSEMBLY OF 10-60450 FRONT RELEASE PLUG-IN RELAY SOCKETS					
		20-9X-XX ASSEMBLY OF BACN15C AND BURNDY YHLZD-() AND YHLZR-() TERMINAL BLOCK MODULES					

20-00-00 GENERAL	20-00-00 GENERAL	20-00-00 SAFETY PRACTICES							
20-10-00 WIRING PROCEDURES	20-10-00 SAFETY PRACTICES	20-10-11 INSTALLATION OF ELECTRICAL WIRES AND WIRES HARNESSSES							
20-10-01 WIRING PROCEDURES		20-10-12 WIRE HARNESS SUPPORTS							
20-10-02 SHIELDING-MAINTENANCE PRACTICES		20-10-13 REPAIR OF ELECTRICAL WIRE AND COAX CABLE							
20-10-03 WIRE SPICING MAINTENANCE PRACTICES		20-10-14 INSTALLATION OF SHRINKABLE SLEEVES							
20-10-04 COIL AND STOW MAINTENANCE PRACTICES		20-10-15 TERMINATION OF CABLE SHIELDS							
20-10-05 SOLDERING PROCEDURES MAINTENANCE PRACTICES		20-10-16 HEAT SHRINKABLE FITTINGS							
20-10-06 HEAT SHRINKABLE TUBING-MAINTENANCE PRACTICES		20-10-17 INSTALLATION OF ZIPPERTUBING							
20-11-00 FLIGHT GUIDANCE SYSTEM		20-10-18 INSTALLATION OF SLEEVES ON WIRING							
		20-10-19 WIRE SEPARATION							
		20-10-20 INSTALLATION OF PRESSURE BULKHEAD SEALS							
		20-10-21 POWER FEEDER WIRE HARNESS RACEWAY SEAL							
		20-10-21 REPAIR OF FLEXIBLE ELECTRICAL CONDUITS							
		20-11-11 ARINC 629 DATA BUS							
		20-12-11 S280W701-() FIBER OPTIC CABLE ASSEMBLIES							
		20-14-11 REPAIR OF PRIMARY FLIGHT CONTROL SYSTEM WIRE HARNESSSES							
		20-14-51 ASSEMBLY OF THE FLIGHT RECORDER AIDS WIRE HARNESS WITH A BACC83AF() FIREWALL CONNECTOR							

TABLE 1: GROUPS, SEQUENCE, AND DESCRIPTION OF MAJOR TOPICS

GROUP	MAJOR TOPIC	DESCRIPTION
GENERAL DATA	SAFETY PRACTICES	Safety regulations and general safety precautions to prevent injury to personnel and damage to the airplane
	AIRPLANE ENVIRONMENTAL AREAS	Definition of types of areas upon which wiring configuration and wiring component selection is constrained
	CONSUMABLE MATERIALS	Wiring maintenance processing materials; e.g., solvents, aqueous cleaners, lubricants, etc.
	WIRING MATERIALS	Materials that become an integral part of the wiring configuration excluding wire and cable; e.g., sleeves, shield material, tie material, sealants, etc.
WIRING INSPECTION AND REPAIR	WIRE AND CABLE TYPES	The principal material component of airplane wiring; includes type identification and basic description; alternative wire types (replacements, substitutions)
	WIRING INSPECTION	Criteria for correct installation, correct wiring assembly configuration; damage conditions and limits for wiring components (wire and cable, termination types, electrical devices); factors that warrant component disassembly for internal inspection; determination of cause of damage; wiring integrity testing
	WIRE HARNESS CLEANING	In support of inspection as well as prevention of degradation and preparation for repair; recommended cleaning materials and procedures based on type of contamination
	WIRE HARNESS DISASSEMBLY	In support of inspection, cleaning when applicable; also supports new wiring installation
	WIRING REPAIR AND REPLACEMENT	Repair of wiring installation, wiring assembly configuration, wiring components (wire and cable, wiring terminations, electrical devices); wire and cable replacement; wiring functional identification
WIRING INSTALLATION	WIRE SEPARATION	Explanation of separation categories, separation identification, and necessary conditions for maintaining separation
	ELECTRICAL BONDS AND GROUNDS	Bond surface preparation, ground hardware configurations, bond integrity testing
	WIRE HARNESS INSTALLATION	Routing, supports; wiring protection, factors affecting wiring assembly configuration; connection to equipment, new wiring, removal from service
WIRING ASSEMBLY	WIRE MARKING	Marking; applicable conditions
	WIRE HARNESS ASSEMBLY	Wiring assembly configuration: assembly materials, layout, overall protection; factors affecting wiring installation
WIRING TERMINATIONS	WIRE INSULATION AND CABLE JACKET REMOVAL	Wire and cable: Insulation removal, jacket removal; associated damage limits
	TERMINATION TYPE	Wiring terminations (interconnects) and accessories grouped by component type from simple to complex: <ul style="list-style-type: none"> a. Common data by group (if any); e.g., tool description and operation, definition of internal damage and limits, internal cleaning, accessories b. By individual type - part numbers and description, definition of internal damage and limits (if not specified by common data), disassembly, assembly, installation
ELECTRICAL DEVICES	DEVICE TYPE	Electrical devices by group: <ul style="list-style-type: none"> a. Common data by group (if any); e.g., tool description and operation, definition of internal damage and limits, internal cleaning, accessories b. By individual type - part numbers and description, definition of internal damage and limits (if not specified by common data), disassembly, assembly, installation

TABLE 1: GROUPS, SEQUENCE, AND DESCRIPTION OF MAJOR TOPICS

GROUP	MAJOR TOPIC	DESCRIPTION
SPECIFIC SYSTEM WIRING	SPECIFIC WIRING ASSEMBLY	For wiring that has a necessarily specific configuration: - Applicable conditions for repair and replacement - Disassembly, assembly, installation, assembly integrity testing
AIRLINE CUSTOMIZED DATA	AIRLINE SPECIFIED	Reserved for airline use

TABLE 2: RECOMMENDED ATA NUMBERING OF MINIMUM CONTENT

ATA	GROUP	MAJOR TOPIC
20-0X-XX	GENERAL DATA	SAFETY PRACTICES
		AIRPLANE ENVIRONMENTAL AREAS
		CONSUMABLE MATERIALS
		WIRING MATERIALS
20-1X-XX	WIRING INSPECTION AND REPAIR	WIRE AND CABLE TYPES
		WIRING INSPECTION
		WIRE HARNESS CLEANING
		WIRE HARNESS DISASSEMBLY
		WIRING REPAIR AND REPLACEMENT
20-2X-XX	WIRING INSTALLATION	WIRE SEPARATION
		ELECTRICAL BONDS AND GROUNDS
		WIRE HARNESS INSTALLATION
20-3X-XX	WIRING ASSEMBLY	WIRE MARKING
		WIRE HARNESS ASSEMBLY
20-4X-XX 20-5X-XX 20-6X-XX	WIRING TERMINATIONS	WIRE INSULATION AND CABLE JACKET REMOVAL
		TERMINATION TYPE
20-7X-XX	ELECTRICAL DEVICES	DEVICE TYPE
20-8X-XX	SPECIFIC SYSTEM WIRING	SPECIFIC WIRING ASSEMBLY
20-9X-XX	AIRLINE CUSTOMIZED DATA	AIRLINE SPECIFIED

TABLE 3: REPRESENTATIVE DETAILS OF MINIMUM CONTENT

GROUP	MAJOR TOPIC	SUB-TOPIC	NOTES
GENERAL DATA	SAFETY PRACTICES	Electrical Safety	
		Fire Safety	
		Hazardous Material Safety	
		Wiring Protection During Maintenance	Both wiring and non-wiring maintenance
		ESDS Components and Assemblies	
	AIRPLANE ENVIRONMENTAL AREAS	Pressurized / Unpressurized	
		Temperature	
		Flammable Leakage	
		Swamp	
	CONSUMABLE MATERIALS	Part Numbers and Description	Suppliers implied
		Hazardous Conditions	
		Equivalent Alternatives	
	WIRING MATERIALS	Part Numbers and Description	Suppliers implied
		Environmental Suitability	
Equivalent Alternatives			

TABLE 3: REPRESENTATIVE DETAILS OF MINIMUM CONTENT

GROUP	MAJOR TOPIC	SUB-TOPIC	NOTES
WIRING INSPECTION AND REPAIR	WIRE AND CABLE TYPES	Part Numbers and Description	Suppliers implied
		Construction	Necessary for repair criteria
		Equivalent Alternatives	
	WIRING INSPECTION	Installation	Support damage conditions and limits
			Satisfactory routing, sufficient support
			Correct separation
		Wiring Assembly Configuration	Correct configuration for area
			Correct protection for installation
		Wiring Components	External damage condition of wire, wiring termination types, electrical devices
			Damage limits for wire, wiring termination types, electrical devices
	Criteria for more detailed inspection		
	Electrical Tests	Continuity	
		Insulation Resistance	
		Reflectometry	
		Wiring Shield Integrity (Loop Resistance)	
WIRE HARNESS CLEANING	Light Contamination	Fluid / solid by environmental area	
	Heavy Contamination	Fluid / solid by environmental area	
WIRE HARNESS DISASSEMBLY			
WIRING REPAIR AND REPLACEMENT	Installation Repair		
	Wiring Assembly Configuration Repair		
	Wire and Cable Repair		
	Wiring Component Repair		

TABLE 3: REPRESENTATIVE DETAILS OF MINIMUM CONTENT

GROUP	MAJOR TOPIC	SUB-TOPIC	NOTES
WIRING INSTALLATION	WIRE SEPARATION / SEGREGATION	Applicable Conditions	
		Identification	
		Compliance	Maintenance
	ELECTRICAL BONDS AND GROUNDS	Ground Configuration Assembly	
		Bond Surface Preparation	
		Bond Integrity Tests	
	WIRE HARNESS INSTALLATION	Routing	
		Protection	
		Wiring Supports	
		Connection to Equipment	
		New Wiring	
		Wiring Removal from Service	Cap and stow
		Functional Identification	

TABLE 3: REPRESENTATIVE DETAILS OF MINIMUM CONTENT

GROUP	MAJOR TOPIC	SUB-TOPIC	NOTES
WIRING ASSEMBLY	WIRE MARKING	Indirect Marks	
		Direct Marks	
	WIRE HARNESS ASSEMBLY	Wire Harness Formation	Ties, branches, drip loops
		Installation of Shrinkable Sleeves	
		Installation of Protective Sleeves	
		Assembly of Shield Ground Wires	

TABLE 3: REPRESENTATIVE DETAILS OF MINIMUM CONTENT

GROUP	MAJOR TOPIC	SUB-TOPIC	NOTES
WIRING TERMINATIONS	WIRE INSULATION AND CABLE JACKET REMOVAL	Removal Tools by Wire Type	Suppliers implied
		Removal Procedure	
	WIRING TERMINATION TYPE COMMON DATA	Common Tools and Operation	Suppliers, procedure implied
		Internal Damage Conditions	
		Internal Damage Limits	
		Internal Cleaning	
		Common Accessory Assembly	
	TERMINATION TYPE	Part Numbers and Description	Suppliers implied
		Unique Internal Damage Conditions	
		Unique Internal Damage Limits	
		Component Disassembly	
		Component Assembly	
		Unique Accessory Assembly	
		Component Installation	

TABLE 3: REPRESENTATIVE DETAILS OF MINIMUM CONTENT

GROUP	MAJOR TOPIC	SUB-TOPIC	NOTES
ELECTRICAL DEVICES	ELECTRICAL DEVICE TYPE COMMON DATA	Common Tools and Operation	Suppliers, procedure implied
		Internal Damage Conditions	
		Internal Damage Limits	
		Internal Cleaning	
		Common Accessory Assembly	
	ELECTRICAL DEVICE TYPE	Part Numbers and Description	Suppliers implied
		Unique Internal Damage Conditions	
		Unique Internal Damage Limits	
		Component Disassembly	
		Component Assembly	
		Unique Accessory Assembly	
		Component Installation	

TABLE 3: REPRESENTATIVE DETAILS OF MINIMUM CONTENT

GROUP	MAJOR TOPIC	SUB-TOPIC	NOTES
SPECIFIC SYSTEM WIRING	SPECIFIC WIRING ASSEMBLY	Assembly Part Numbers	
		Component Part Numbers	Reference to component data for description
		Conditions for Repair and Replacement	
		Component Cleaning	Reference to applicable common data
		Disassembly	May be duplicate; repeated for convenience
		Assembly	May be duplicate; repeated for convenience
		Installation	May be duplicate; repeated for convenience
		Test	Reference to applicable common data

TABLE 3: REPRESENTATIVE DETAILS OF MINIMUM CONTENT

GROUP	MAJOR TOPIC	SUB-TOPIC	NOTES
AIRLINE CUSTOMIZED DATA	As Specified By Airline		